VERSION 3

Missile Defense Agency (MDA)
22.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Missile Defense Agency's (MDA) mission is to develop and deploy a layered Missile Defense System (MDS) to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight.

The MDA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the MDA SBIR/Small Business Technology Transfer (STTR) Program Management Office (PMO), located within the Innovation, Science, & Technology (DV) directorate.

Offerors responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. MDA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the MDA SBIR Program and these proposal preparation instructions should be directed to:

Missile Defense Agency
SBIR/STTR Program Management Office
MDA/DVR
Bldg. 5224, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil
Phone: 256-955-2020

Proposals not conforming to the terms of this announcement may not be considered. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by MDA will be funded. MDA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD announcement and MDA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about#policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

DSIP (available at https://www.dodsbirsttr.mil) will lead you through the preparation and submission of your proposal. Read the front section of the DoD announcement for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this announcement may not be considered.

MDA's objective for Phase I is to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I is six (6) months.

Proposal Cover Sheet (Volume 1)
On DSIP at https://www.dodsbirsttr.mil/submissions, prepare the Proposal Cover Sheet.

Technical Volume (Volume 2)
The technical volume is not to exceed 15 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages submitted beyond the 15-page limit will not be evaluated.

Content of the Technical Volume
For technical volume format guidance, please refer to the "Format of Technical Volume" section within the DoD SBIR 22.1 BAA

If including a letter(s) of support and/or Technical and Business Assistance (TABA) request, it must be included as part of Volume 5 and will not count towards the 15-page Technical Volume (Volume 2) limit. Any technical data/information that should be in the Technical Volume (Volume 2) but is contained in other Volumes will not be considered.

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $150,000 or not to exceed $155,000 if TABA is included. MDA does not utilize the Phase I Option.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by MDA during proposal evaluations.

Supporting Documents (Volume 5)
MDA will only accept the following four documents as part of Volume 5:
1. Contractor Certification Regarding Provision of Prohibited Video Surveillance and Telecommunications Services and Equipment (Required).
2. Foreign Ownership or Control Disclosure (Offerors must review Attachment 2 in the DoD SBIR Program BAA to determine applicability.)
3. Request for TABA using the MDA Phase I TABA form (optional).
4. Letters of support (optional).

If including a request for TABA, the MDA Phase I TABA Form MUST be completed and uploaded using the "Other" category within Volume 5 of DSIP.

If including letters of support, they MUST be uploaded using the "Letters of Support" category within Volume 5 of DSIP. A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what MDS need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. Letters of support shall not be contingent upon award of a subcontract.

Any documentation other than the Prohibited Video Surveillance and Telecommunications Services and Equipment form, Foreign Ownership or Control Disclosure, letter(s) of support, or requests for TABA included as part of Volume 5 WILL NOT be considered.

DIRECT TO PHASE II PROPOSAL GUIDELINES
MDA is not accepting Direct to Phase II proposals for the 22.1 SBIR BAA.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR Program Management Office during the fourth month of the Phase I period of performance.

MDA will evaluate and select Phase II proposals using the Phase II evaluation criteria listed in the DoD Program announcement. While funding must be based upon the results of work performed under a Phase I award and the scientific and technical merit, feasibility and commercial potential of the Phase II proposal, Phase I final reports will not be reviewed as part of the Phase II evaluation process. The Phase II proposal should include a concise summary of the Phase I effort including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I effort, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system. It is strongly urged that an approved accounting system be in place prior to the MDA Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay/prevent Phase II contract award. Please visit https://www.dcaa.mil/Customers/Small-Business for more information on obtaining a DCAA approved accounting system.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
The SBIR/STTR Policy Directive allows agencies to enter into agreements with suppliers to provide technical assistance to SBIR and STTR awardees, which may include access to a network of scientists and engineers engaged in a wide range of technologies or access to technical and business literature available through on-line data bases.

All requests for TABA must be completed using the MDA SBIR/STTR Phase I TABA Form and included as a part of Volume 5 of the proposal package. MDA will not accept requests for TABA that do not utilize the MDA SBIR/STTR Phase I TABA Form or are not provided as part of Volume 5 of the Phase I proposal package.

A SBIR firm may acquire the technical assistance services described above on its own. Firms must request this authority from MDA and demonstrate in its SBIR proposal that the individual or entity selected can provide the specific technical services needed. In addition, costs must be included in the cost volume of the offeror's proposal. The TABA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

If the awardee supports the need for this requirement sufficiently as determined by the Government, MDA will permit the awardee to acquire such technical assistance, in an amount up to $5,000 per year. This will be an allowable cost on the SBIR award. The per year amount will be in addition to the award and is not subject to any burden, profit or fee by the offeror. The per-year amount is based on the original contract period of performance and does not apply to period of performance extensions. Requests for TABA funding outside of the base period of performance (6 months) for Phase I proposal submission will not be considered.

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The purpose of this technical assistance is to assist SBIR awardees in:
1. Making better technical decisions on SBIR projects;
2. Solving technical problems that arise during SBIR projects;
3. Minimizing technical risks associated with SBIR projects; and
4. Developing and commercializing new commercial products and processes resulting from such projects including intellectual property protections.

The MDA Phase I TABA form can be accessed here: (https://www.mda.mil/global/documents/pdf/SBIR_STTR_PHI_TABA_Form.pdf) and must be included as part of Volume 5 using the "Other" category.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. Selections will be based on best value to the Government considering the evaluation criteria listed in the DoD SBIR Program BAA which are listed in descending order of importance.

MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the offeror before award of any contract. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality as determined by MDA will be funded.

Please note that potential benefit to the MDS will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions only on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be listed in the proposal and will count toward the applicable page limit.

AWARD AND CONTRACT INFORMATION

The MDA Contracting Office will distribute selection and non-selection email notices to all firms who submit an MDA SBIR proposal. Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet and will originate from the sbirsttr@mda.mil email address. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

MDA will provide written feedback to unsuccessful offerors regarding their proposals upon request. Requests for feedback must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting proposal feedback. Only firms that receive a non-selection notification are eligible for written feedback. Refer to the DoD SBIR Program BAA for procedures to protest the announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to Tina Barnhill via email: sbirsttr@mda.mil.

AWARD AND CONTRACT INFORMATION

The Missile Defense Agency will issue all contract awards. The cognizant Government Contracting Officer is the only Government official authorized to enter into any binding agreement or contract on behalf of the Government.

Offeror Small Business Eligibility Requirements

Each offeror must qualify as a small business at time of award per the Small Business Administration's (SBA) regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Small businesses that are selected for award will also be required to submit a Funding Agreement Certification document and be registered with Supplier Performance Risk System https://www.sprs.csd.disa.mil/ prior to award.

Ownership Eligibility

Prior to award, MDA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR/STTR Program Eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers. If requested by MDA, the contractor shall provide all necessary documentation for evaluation prior to SBIR award. Failure to submit the requested documentation in a timely manner as indicated by MDA may result in the offeror's ineligibility for further consideration for award.

Performance Benchmark Requirements for Phase I Eligibility

MDA does not accept proposals from firms that are currently ineligible for Phase I awards as a result of failing to meet the benchmark rates at the last assessment. Additional information on Benchmark Requirements can be found in the DoD SBIR/STTR Program BAA.

References to Hardware, Computer Software, or Technical Data

In accordance with the SBIR/STTR Policy Directive, SBIR/STTR contracts are to conduct feasibility-related experimental or theoretical R/R&D related to described agency requirements. The purpose for Phase I is to determine the scientific and technical merit and feasibility of the proposed effort.

It is not intended for any formal end-item contract delivery and ownership by the Government of your hardware, computer software, or technical data. As a result, your technical proposal should not contain any reference to the term "Deliverables" when referring to your hardware, computer software, or technical data. Instead use the term: "Products for Government Testing, Evaluation, Demonstration, and/or possible destructive testing."

The standard formal deliverables for a Phase I are the:
A001: Report of Invention(s), Contractor, and/or Subcontractor(s) // Patent Application for Invention
A002: Status Report // Phase I Bi-monthly Status Report
A003: Contract Summary Report // Phase I Final Report
A004: Certification of Compliance // SBIR Funding Agreement Certification - Life Cycle Certification
A005: Computer Software Product // Product Description
A006: Technical Report - Study Services // Prototype Design and Operation Document

FAR 52.203-5 Covenant Against Contingent Fees

As prescribed in FAR 3.404, the following FAR 52.203-5 clause shall be included in all contracts awarded under this BAA:

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) Bona fide agency, as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

ADDITIONAL INFORMATION

Federally Funded Research and Development Centers (FFRDCs) and Support Contractors

Only Government personnel with active non-disclosure agreements will evaluate proposals. Non-Government technical consultants (consultants) to the Government may review and provide support in proposal evaluations during source selection. Consultants may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. Consultants will not establish final assessments of risk and will not rate or rank offerors' proposals. They are also expressly prohibited from competing for MDA SBIR awards in the SBIR topics they review and/or on which they provide comments to the Government.

All consultants are required to comply with procurement integrity laws. Consultants will not have access to proposals or pages of proposals that are properly labeled by the offerors as "Government Only." Pursuant to FAR 9.505-4, the MDA contracts with these organizations include a clause which requires them to (1) protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than that for which it was furnished. In addition, MDA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the MDA SBIR/STTR PMO.

Non-Government consultants will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the aforementioned organizations may require access to proprietary information contained in the offerors' proposals.

SBA Company Registry

Per the SBIR/STTR Policy Directive, all applicants are required to register their firm at SBA's Company Registry prior to submitting a proposal. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the eleven (11) participating agencies in the SBIR or STTR program. For more information, please visit the SBA's Firm Registration Page: http://www.sbir.gov/registration.

Organization Conflicts of Interest (OCI) and Unfair Competitive Advantage
The basic OCI rules for Contractors which support development and oversight of SBIR topics are covered in FAR 9.5 as follows (the Offeror is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract;

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All applicable rules under the FAR Section 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any SBIR requirement or topic, please be advised that your company may have an OCI. Your company could be precluded from an award under this Broad Agency Announcement (BAA) if your proposal contains anything directly relating to the development of the requirement or topic. Before submitting your proposal, please examine any potential OCI issues that may exist with your company to include subcontractors and understand that if any exist, your company may be required to submit an acceptable OCI mitigation plan prior to award.

In addition, FAR 3.101-1 states that Government business shall be conducted in a manner above reproach and, except as authorized by statute or regulation, with complete impartiality and with preferential treatment for none. The general rule is to avoid strictly any conflict of interest or even the appearance of a conflict of interest in Government-contractor relationships. An appearance of impropriety may arise where an offeror may have gained an unfair competitive advantage through its hiring of, or association with, a former Government official if there are facts indicating the former Government official, through their former Government employment, had access to non-public, competitively useful information. (See *Health Net Fed. Svcs*, B-401652.3; *Obsidian Solutions Group*, LLC, B-417134, 417134.2). The existence of an unfair competitive advantage may result in an offeror being disqualified and this restriction cannot be waived.

It is MDA policy to ensure all appropriate measures are taken to resolve OCI's arising under FAR 9.5 and unfair competitive advantages arising under FAR 3.101-1 to prevent the existence of conflicting roles that might bias a contractor's judgment and deprive MDA of objective advice or assistance, and to prevent contractors from gaining an unfair competitive advantage.

Use of Foreign Nationals (also known as Foreign Persons), Green Card Holders, and Dual Citizens
See the "Foreign Nationals" section of the DoD SBIR Program announcement for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals, green-card holders, or dual citizens, MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign nationals or individuals holding dual citizenship expected to be involved on this project as a direct employee, **subcontractor, or consultant.** For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens, or green card holders listed will be subject to security review during the contract negotiation process (if selected for award). MDA reserves the right to vet all un-cleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed person and/or firm is found ineligible by the Government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but is not required to disclose the underlying rationale.

Export Control Restrictions

The technology within most MDA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export controlled items based on user, country, and purpose. The offeror must ensure that their firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: https://www.pmddtc.state.gov/ and https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.

Most MDA SBIR topics are subject to ITAR and/or EAR. If the topic write-up indicates that the topic is subject to ITAR and/or EAR, your company may be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

Flow-Down of Clauses to Subcontractors

The clauses to which the prime contractor and subcontractors are required to comply include, but are not limited to the following clauses: MDA clause H-08 (Public Release of Information), DFARS 252.204-7000 (Disclosure of Information), DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), and DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements). Your proposal submission confirms that any proposed subcontract is in accordance to the clauses cited above and any other clauses identified by MDA in any resulting contract. All proposed universities will need to provide written acceptance of the Flow-Down Clauses in both SBIR and STTR proposals.

MDA Clause H-08 Public Release of Information (Publication Approval)

MDA Clause H-08 pertaining to the public release of information is incorporated into all MDA SBIR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under MDA SBIR contracts must be submitted to MDA for review and approval prior to its release to the public. This mandatory clause also includes the subcontractor who shall provide their submission through the prime contractor for MDA's review for approval.

a. In addition to the requirements of National Industrial Security Program Operations Manual (DoD 5220.22-M), all foreign and domestic contractor(s) and its subcontractors are required to comply with the following:

1) Any official MDA information/materials that a contractor/subcontractor intends to release to the public that pertains to any work under performance of this contract, the Missile Defense Agency (MDA) will perform a prepublication review prior to authorizing any release of information/materials.

2) At a minimum, these information/materials may be technical papers, presentations, articles for publication, key messages, talking points, speeches, and social media or digital media, such as press releases, photographs, fact sheets, advertising, posters, videos, etc.

b. Subcontractor public information/materials must be submitted for approval through the prime contractor to MDA.

c. Upon request to the MDA Procuring Contracting Officer (PCO), contractors shall be provided the "Request for Industry Media Engagement" form (or any superseding MDA form).

d. At least 45 calendar days prior to the desired release date, the contractor must submit the required form and information/materials to be reviewed for public release to MDAPressOperations@mda.mil, and simultaneously provide courtesy copy to the appropriate PCO.

e. All information/materials submitted for MDA review must be an exact copy of the intended item(s) to be released, must be of high quality and are free of tracked changes and/or comments. Photographs must have captions, and videos must have the intended narration included. All items must be marked with the applicable month, day, and year.

f. No documents or media shall be publically released by the Contractor without MDA Public Release approval.

g. Once information has been cleared for public release, it resides in the public domain and must always be used in its originally cleared context and format. Information previously cleared for public release but containing new, modified or further developed information must be re-submitted

Rights in Noncommercial Technical Data and Computer Software – SBIR Program (DFARs 252.227-7018)
Use this link for full description of Data Rights:
https://www.acquisition.gov/dfars/part-252-solicitation-provisions-and-contract-clauses#DFARS-252.227-7018

Fraud, Waste, and Abuse
All offerors must complete the fraud, waste, and abuse training (Volume 6) that is located on DSIP (https://www.dodsbirsttr.mil). Please follow guidance provided on DSIP to complete the required training.

To Report Fraud, Waste, or Abuse, Please Contact:
MDA Fraud, Waste & Abuse
Hotline: (256) 313-9699
MDAHotline@mda.mil

DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: (800) 424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this announcement.

Proposal Submission

All proposals MUST be submitted online using DSIP (https://www.dodsbirsttr.mil). Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk: DoDSBIRSupport@reisystems.com.

It is recommended that potential offerors email topic authors to schedule a time for topic discussion during the pre-release period.

Classified Proposals

Classified proposals **ARE NOT** accepted under the MDA SBIR Program. The inclusion of classified data in an unclassified proposal MAY BE grounds for the Agency to determine the proposal as non-responsive and the proposal not to be evaluated. Contractors currently working under a classified MDA SBIR contract must use the security classification guidance provided under that contract to verify new SBIR proposals are unclassified prior to submission. Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on Phase II contracts will require security clearances. If a Phase II contract will require classified work, the offeror must have a facility clearance and appropriate personnel clearances in order to perform the classified work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency Web site at: https://www.dcsa.mil.

Use of Acronyms

Acronyms should be spelled out the first time they are used within the technical volume (Volume 2), the technical abstract, and the anticipated benefits/potential commercial applications of the research or development sections. This will help avoid confusion when proposals are evaluated by technical reviewers.

Communication

All communication from the MDA SBIR/STTR PMO will originate from the sbirsttr@mda.mil email address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

Proposal titles, abstracts, anticipated benefits, and keywords of proposals that are selected for contract award will undergo an MDA Policy and Security Review. Proposal titles, abstracts, anticipated benefits, and keywords are subject to revision and/or redaction by MDA. Final approved versions of proposal titles, abstracts, anticipated benefits, and keywords may appear on DSIP and/or the SBA's SBIR/STTR award site (https://www.sbir.gov/sbirsearch/award/all).

Approved for Public Release
21-MDA-11034 (20 Dec 21)

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MDA SBIR 22.1 Phase I Topic Index

MDA22-001	Advanced Manufacturing Technology for Coatings and Coating Systems
MDA22-002	Innovative Methodologies for Modeling of EO/IR Sensors in a Radiation Environment
MDA22-003	High Temperature Materials for Solid Propulsion Pintles
MDA22-004	Higher Performance Solid Propellants
MDA22-005	Substrates for High Temperature Electronics
MDA22-006	Object Detection, Tracking, and Identification in a Congested Environment Using Artificial Intelligence (AI) Enabled Algorithms
MDA22-007	Predictive Error Correction Algorithm for Hypersonic Applications
MDA22-008	Packaging High Temperature Electronics for Harsh Flight Environments
MDA22-009	Homeland Defense Interceptor Technologies
MDA22-010	Homeland Defense Weapon System Software Development Processes
MDA22-011	[TOPIC REMOVED]
MDA22-012	Ground Safing Enhancements
MDA22-013	Solid Propellant Oxidizer Alternative to Ammonium Perchlorate

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MDA22-001 TITLE: Advanced Manufacturing Technology for Coatings and Coating Systems

OUSD (R&E) MODERNIZATION PRIORITY: Space

TECHNOLOGY AREA(S): Materials

OBJECTIVE: Increase confidence in the surface treatments industrial base to provide critical coatings when necessary. Increase yield of coating processes and decrease human factors that degrade product quality.

DESCRIPTION: The Government utilizes coatings within its systems and for advanced manufacturing processes, however, coating procurement, such as electroplating, has presented risks due to the number of processing variables, the human touch-time factors, and sometimes environmental concerns. The industry struggles to advance in these areas as profit margins are often too small to justify manufacturing technology improvements.

The Government is interested in tools, techniques, systems, and/or material replacements to improve coatings manufacturing technology. Ideally, coating systems would be easier to control and environmentally safer than current market options. An example of space relevant coatings would include electroplating of precious metals. The solution would result in a higher availability of high quality coatings, either via coatings providers or as systems to be installed with Original Equipment Manufacturers (OEM)s.

One area of special interest are the dielectric or insulating coatings on tool-pieces used in electro-chemical machining (ECM). ECM appears to be a promising technique for micro-machining a large number of smooth narrow channels in the heat exchangers and injectors used in missile defense power electronic or aerospace systems. Improved coatings should not only improve the ECM precision but should also reduce ECM environmental impact by increasing tool lifetime and minimizing hazardous waste. These coatings should be very thin, uniform (without any breaks), well-adhered to the tool surface, and resistant to both applied voltages and the harsh/corrosive process environment. The Government currently envisions a non-exclusive R&D partnership between ECM suppliers and coating suppliers. ECM suppliers would provide requirements, fabricate the tool substrates, and test the coated tools during representative machining trials. Coating suppliers would prepare the tool surface, apply the coats, characterize the coats, and investigate any coating failures. Other arrangements would be considered. Advanced coatings for other micro-machining techniques that are similar to ECM would also be considered as long as it can be shown that these coatings would improve the technique's performance (for missile-defense applications), increase its commercialization prospects, and reduce its environmental footprint.

PHASE I: Establish the technical basis of the solution, with small scale validation and theoretical analysis of the effectiveness. The effort might include small scale design of experiments on test coupons and materials testing.

PHASE II: Down select any competing technologies and provide more extensive testing. If the solution purposes new apparatus, prototypes should be developed for technology demonstration.

PHASE III DUAL USE APPLICATIONS: Demonstrate the solution in relevant test environments, through collaboration with OEMs, or whoever the next higher tier user would be. The technology should be further developed for commercial applicability.

REFERENCES:

1. https://www.osti.gov/pages/biblio/1596174.
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3928744.
3. https://www.epa.gov/sites/default/files/2017-06/documents/electroplating_comm_info.pdf.
4. https://www.researchgate.net/publication/286774967_Study_of_coated_microtools_in_electrochemical_machining_ECM.
5. https://en.wikipedia.org/wiki/Electrochemical_machining.

KEYWORDS: Electrochemical Machining, Electro-Chemical Machining, ECM, PECM, Atomic Layer Deposition, ALD, Diamond-like Coatings, DLC, Electroplating, Metal Deposition

TPOC-1: Jacob Putman
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Email: Jacob.putman@mda.mil

TPOC-2: Aaron Williams
Phone: 256-653-5663
Email: aaron.williams@mda.mil

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MDA22-002 TITLE: Innovative Methodologies for Modeling of EO/IR Sensors in a Radiation Environment

OUSD (R&E) MODERNIZATION PRIORITY: Microelectronics; Space

TECHNOLOGY AREA(S): Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop methodologies and techniques for first principles modeling of radiation effects on EO/IR materials in both a natural space environment and a man-made radiation environment.

DESCRIPTION: Seeking a modeling and simulation tool that will give an improved predictive capability for the assessment of microelectronic survivability in a radiation environment, in order to predict an average rate of defect formation, with the goal of determining the survivability of EO/IR detectors such as HgCdTe, or III-V materials, based on first principles. Modeling of defect formation in EO/IR detector materials in a radiation environment has been explored using molecular dynamics or density functional theory, and advances to these approaches are of interest, but new approaches may also be proposed. A methodology to bridge between analysis that can be done at very small (microscopic) length scales, and macroscopic or device-scale analysis, is also of interest.

PHASE I: Show feasibility of a modeling approach, especially the capability to predict the survivability of an EO/IR detector in a radiation environment.

PHASE II: Demonstrate a prototype modeling tool, benchmarked against test data.

PHASE III DUAL USE APPLICATIONS: Transition to defense applications modeling capabilities.

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1. Schultz and Hjalmarson, From first-principles defect chemistry to device damage models of radiation effects in III-V semiconductors, MMM 2018, Osaka, Japan, https://www.osti.gov/biblio/1593578.
2. Huang et al, Multi-Timescale Microscopic Theory for Radiation Degradation of Electronic and Optoelectronic Devices, American Journal of Space Science, 2015.
3. Nordland et al, Primary radiation damage: A review of current understanding and models, Journal of Nuclear Materials, 512 (2018) 450-479, https://www.osti.gov/pages/biblio/1482433.
4. Adams et al, The SIRE2 Toolkit, Space Weather, 18, e2019SW002364. https://doi.org/10.1029/2019SW002364.
5. Broberg et al, PyCDT: A Python toolkit for modeling point defects in semiconductors and insulators, Computer Physics Communications 226 (2018) 165-179.

KEYWORDS: Molecular dynamics, density functional theory, defect production in Silicon, III-V materials, HgCdTe

VERSION 3

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VERSION 3

MDA22-003 TITLE: High Temperature Materials for Solid Propulsion Pintles

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics

TECHNOLOGY AREA(S): Materials; Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.
OBJECTIVE: Develop pintle shaft materials for use in higher temperature controllable solid propulsion systems.

DESCRIPTION: The Government desires solid propulsion systems with greater impulse and thrust for future systems. Increasing solid propellant burn temperatures, may achieve this goal but also creates thermal challenges for materials. Additionally, the combination of high temperature performance, low thermal conductivity, and high tensile strength significantly limits the selection of available materials for current pintles. This topic seeks improved materials for use in pintle shafts for controllable solid propulsion systems.

A current state of the art material used in pintles is needled carbon silicon carbide (C/SiC). Proposers may focus on improving C/SiC or propose other innovative materials, such as ceramics, metallics, multilayered composites of multiple materials, etc. This topic seeks to exceed tensile properties over existing materials while decreasing thermal conductivity. For composites, the tensile strength in the cross ply direction should be >8ksi at room temperature and >12ksi at 1,000°C. The cross ply thermal conductivity should be less than 20 W/mK at these temperatures. The material must be capable of production to at least 10cm thick. For other materials, the above properties must all be present in one direction, and the tensile strength in other directions must exceed the values stated above.

Proposers may assume that a separate material is used as a coating, cladding, or pintle tip to prevent excessive erosion of the pintle. Alternatively, unitary materials intended to make up the entire pintle shaft and tip are acceptable. Materials for coatings or claddings are outside of the scope of this topic.

PHASE I: Evaluate feasibility of proposed material concept by modeling and simulation and/or proof of concept testing. Material formulation and/or coupon fabrication is recommended to provide evaluation of critical properties. Work with solid propulsion system developers to understand environments.

PHASE II: Continue material and process development through design, analysis, and experimentation. Optimize processing parameters for yield and quality. Material testing should be conducted to validate material models and generate property databases. Demonstration in a representative environment is desired. Phase II should identify an insertion opportunity and conclude with a mature manufacturing process.

PHASE III DUAL USE APPLICATIONS: Work with a solid propulsion system manufacturer to iteratively design and fabricate prototype components for high-fidelity testing in a relevant solid rocket motor environment for current or future missile defense applications. A successful Phase III would provide the necessary technical data to transition the technology into a missile defense application.

REFERENCES:

1. U.S. Missile Defense Agency. August 6, 2021. Missile Defense System. Retrieved from http://www.mda.mil/index.html.
2. George P. Sutton. 2010. "Rocket Propulsion Elements." 8th edition, John Wiley & Sons Inc.
3. James D. Beardsley. 1976. United States Patent #3,948,042, "System for Controlling the Nozzle Throat Area of a Rocket Motor."

KEYWORDS: Materials, Propulsion, Composites, Fiber Preforms

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VERSION 3

MDA22-004 TITLE: Higher Performance Solid Propellants

OUSD (R&E) MODERNIZATION PRIORITY: Space

TECHNOLOGY AREA(S): Air Platform; Ground Sea; Materials

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an energy dense and highly efficient solid propellant.

DESCRIPTION: Higher performing and efficient solid propellants will give maneuvering kill vehicles more delta-v for a successful intercept (in divert attitude control systems and other thrust vector control concepts) as well as faster boost phase velocities. Typical propellant performance limitations usually arise from incomplete aluminum combustion (for aluminized propellants), manufacturing casting techniques (casting voids/grain inconsistencies), total solids loading percent, and propellant ingredients. Potential propellant ingredient improvements can be in the form of binder, oxidizer, metallic fuel, catalysts or other additives, or the encompassing composition/manufacturing of the propellant. This topic seeks improvements in solid propellants for greater energy density. Applications could include multiple long-term storage environments such as ground, sea-based, or space environments. Proposers could apply improvements to propellants for traditional solid rocket boosters or high slope solid propellants for controllable systems. Proposers could offer solutions to improve traditional composite propellants or ideas in the development/exploration of non-traditional propellant chemistry (e.g. meta-stable solid propellants). Propellants should be classified as Department of Transportation (DOT) 1.3 or higher (cannot be DOT 1.1 or DOT 1.2) for safe storage on naval and air-based vessels. Propellant specific impulse should be greater than 270 seconds at sea level.

PHASE I: Evaluate feasibility of proposed propellant formulation and/or manufacturing techniques. Propellant formulation and/or coupon fabrication is recommended to provide evaluation of mechanical and performance properties to validate initial performance models. Small batches of propellant are expected to be produced and tested. Work with solid propulsion developers/experts to help further define and understand propellant requirements and performance needs.

PHASE II: Continue propellant characterization through experimentation and analysis. The contractor is expected to optimize propellant formulation and manufacturing based on experimentation results. Propellant batch sizes should be scaled up (relative to the Phase I effort) and tested. Phase II should include a hot fire test to demonstrate propellant performance parameters in a relevant environment. Phase II should identify an insertion opportunity and conclude with a matured propellant formulation/manufacturing process.

PHASE III DUAL USE APPLICATIONS: Work with solid propulsion system manufacturers/designers to implement the solid propellant formulation/manufacturing processes into a full-scale hot fire test. A successful Phase III would provide the necessary technical data to transition the technology into a missile defense application.

VERSION 3

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1. https://www.onlinelibrary.wiley.com/toc/15214087/2006/31/1 (Specifically pages 33-69).
2. https://www.sciencedirect.com/science/article/abs/pii/S0010218020301735.
3. https://onlinelibrary.wiley.com/doi/abs/10.1002/prep.19810060502.
4. https://ntrs.nasa.gov/api/citations/20170012397/downloads/20170012397.pdf.
5. https://ntrs.nasa.gov/citations/19780005279.

KEYWORDS: Propellant, Solid Propulsion, Chemistry, Propulsion, Space, Propellant Manufacturing

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MDA22-005 TITLE: Substrates for High Temperature Electronics

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics

TECHNOLOGY AREA(S): Air Platform; Sensors; Electronics

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OBJECTIVE: Develop improved manufacturing or processing of substrate materials for high temperature electronics (HTE) to eliminate or reduce the need for cooling and all its accompanying requirements.

DESCRIPTION: Flight environments pose challenges for the state-of-the-art electronics required by missile-defense interceptors. Temperatures can surpass the MIL-STD-883 method 1011 upper range limit of 125°C. State of the art electronics are limited by the thermal capabilities of semiconductors, such as current silicon materials. Heat can have especially damaging effect on circuits that deal with higher frequencies like communications and sensors. These circuits can become distorted due to higher temperature altering impedance or interfering in other ways with functionality. A large portion of space and power is devoted to cooling or insulating the electronics. This need to cool circuits complicates designs, and can hamper performance. HTE would greatly reduce the size, weight, and power (SWaP) and complexity of the thermal management systems for these interceptors. However, integrated circuits that can withstand temperatures much higher than 125°C cannot be grown on bulk-silicon and must instead be grown on other substrates. Advanced substrate materials are very costly to grow and fashion into wafers. This topic seeks innovative ways to lower this cost in order to promote the wider adoption of HTE which would benefit the Government. Using substrate materials other than bulk-silicon would reduce the effects of heat on electronics and would be highly beneficial to many aspects of missile defense.

Proposed solutions should focus on the use of materials such as silicon carbide, gallium nitride, diamond, or high other temperature materials for wafer production in a new, innovative or novel method. Materials should be capable of operating at up to 300°C. Materials should also have improved radiation tolerance compared to current silicon material. The method should produce high yield to waste ratio, be affordable, and allow for fast wafer production methods.

PHASE I: Design and develop innovative solutions, methods, and concept for improved electronics temperature resilience. Produce paper studies, material fabrication, and/or simulations.

PHASE II: Complete a prototype substrate incorporating Government performance requirements, and demonstrate said prototype. Coordinate with the Government during prototype design and development to ensure that the delivered products will be relevant to ongoing missile defense architecture needs.

PHASE III DUAL USE APPLICATIONS: Use substrate design and or model complex electronics molded after state of the art Commercial Off-the-Shelf units.

REFERENCES:
1. "SiC Die Attach Metallurgy and Processes for Applications up to 500ºC", Ping Zheng and Wayne Johnson, IEEE Transactions on Electronics Packaging Manufacturing Technology, 2156–3950, Sep. 2011.
2. R. Wayne Johnson, Ping Zheng, Alberez Wiggins, Seymour and Leora Peltz, "High Temperature Electronics Packaging", Proceedings of the HITEN, St Catherine's College, Oxford, UK, Sep. 17-19, 2007.
3. Virgil B. Shields, "Applications of Silicon Carbide for High Temperature Electronics and Sensors", Mar 1, 1996, NASA Jet Propulsion Laboratory, Tech Briefs, 20, 3, P.55, ISSN 0145-319X.
4. Hypersonic Weapons and US National Security: A 21st Century Breakthrough. Speier, R., Nacouzi, G., Lee, C. A., & Moore, R. M. (2017).
5. United States, Air Force, Scientific Advisory Board. (2015, May). Technology Readiness for Hypersonic Vehicles.

KEYWORDS: Electronics, substrate, high temperature, semi-conductor, and radiation tolerance

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VERSION 3

MDA22-006 TITLE: Object Detection, Tracking, and Identification in a Congested Environment Using Artificial Intelligence (AI) Enabled Algorithms

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence / Machine Learning; Network Command, Control and Communications

TECHNOLOGY AREA(S): Sensors

OBJECTIVE: Develop and validate AI-enabled algorithms and associated software capable of detecting, tracking, and identifying objects in a congested environment using data streams from radio frequency (RF) (e.g., passive, bi-static, synthetic aperture radar (SAR)) detection systems).

DESCRIPTION: This topic seeks to develop AI-enabled algorithms and associated software capable of using data streams and/or data collected by sensors to enable detection, tracking, and identification of targets in a congested environment. Software would be expected to determine position and velocity and track objects in the field of view (FOV) or field of regard (FOR) of the sensor(s). Data streams of interest are those other than the traditional RF radar sources. Applicable data streams could include commercially available data streams for example.

Ideally, the technology (AI-enabled algorithms and software) would be capable of establishing a fingerprint or signature for individual objects in a given environment through training or modeling in a controlled setting, i.e. in an area around an airport or a navigable waterway where cooperative objects are readily available and can be identified and tracked using online resources (e.g. https://flightaware.com, https://www.adsbexchange.com, and https://www.marinetraffic.com).

For missile defense applications, which can include air, sea, and space security around valued assets as well as defense against threats, the technology would require rapid adaptability to diverse environments and extrapolation of data available on cooperative, non-cooperative, or deliberately deceptive targets. Solutions should apply to sensors using RF data streams, such as passive, bi-static, or SAR detection systems.

PHASE I: Describe architecture and concept of operations applicable to missile defense applications and missions. Develop initial AI-enabled algorithms and describe their ability to distinguish between similar objects and to track objects of interest.

PHASE II: Develop prototype AI-enabled algorithms and associated software. Demonstrate ability of the algorithms to detect, track, and identify objects in a congested environment using available data streams, such as from commercial airport and seaport websites.

PHASE III DUAL USE APPLICATIONS: Implement the software into a missile defense relevant sensor system to demonstrate effectiveness. Sensors may be ground, sea, or space-based to detect, track, and identify threat in a congested environment. Additionally, post intercept assessment would be applicable to space-based sensors. Other civilian and commercial uses should be assessed.

REFERENCES:
1. P. Lang, X. Fu, M. Martorella, et.al, Comprehensive Survey of Machine Learning Applied to Radar Signal Processing, arXiv:2009.13702v1 [eess.SP].
2. W. M. Lees , A. Wunderlich , P. J. Jeavons, et.al, Deep Learning Classification of 3.5-GHz Band Spectrograms With Applications to Spectrum Sensing, IEEE Transactions on Cognitive Communications and Networking, Vol. 5, No. 2, June 2019.

3. B. Yonel , E. Mason , and B. Yazici, Deep Learning for Passive Synthetic Aperture Radar, IEEE Journal of Selected Topics in Signal Processing, Vol. 12, No. 1, Feb. 2018.
4. S. Mahfouz, F. Mourad-Chehade, P. Honeine, et.al, Target tracking using machine learning and Kalman filter in wireless sensor networks, IEEE Sensors Journal, IEEE, 2014, 14 (10), pp.3715 – 3725.
5. F. Santi and D. Pastina, A Parasitic Array Receiver for ISAR Imaging of Ship Targets Using a Coastal Radar, Hindawi Publishing Corporation, International Journal of Antennas and Propagation, Vol. 2016, Art. ID 8485305. http://dx.doi.org/10.1155/2016/8485305.

KEYWORDS: Artificial intelligence, AI, machine learning, data fusion

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VERSION 3

MDA22-007 TITLE: Predictive Error Correction Algorithm for Hypersonic Applications

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics

TECHNOLOGY AREA(S): Air Platform

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OBJECTIVE: Determine best method to implement predictive algorithm for instantaneous error analysis and processing for hypersonic navigation applications.

DESCRIPTION: Hypersonic vehicles can have large inertial measurement errors due to their flight patterns and speeds. The need for rapid error correction or even predictive methods to apply adjustments in anticipation of accumulated errors is necessary to ensure flight accuracy. Use of Kalman filters is a common state of the art approach. This topic seeks software improvements beyond state of the art that can be applied to existing IMUs. Proposed solutions could focus on new algorithms, improved Kalman filter, applications of machine leaning, or artificial intelligence to hypersonic navigation that would allow for more precise use of hypersonic applications in defense schemas.

Solution should be a stand-alone algorithm or solution that can be incorporated into future missile defense hardware. Solutions should increase error correction estimates by greater than 25%. Solutions should also maintain accuracy for at least 200s without GPS input at 200Hz sampling rate or higher.

PHASE I: Design and develop innovative solutions, methods, and concepts to correct or mitigate current and anticipated error in hypersonic inertial measurement units in real time. The solutions should capture the key areas for new development, suggest appropriate methods and algorithms to minimize the time intensive processes, and incorporate new technologies researched during the design and development.

PHASE II: Complete/refine a detailed algorithm incorporating Government performance requirements and current leading edge methods. Coordinate with the Government during design and development to ensure that the delivered products will be relevant to an ongoing missile defense architecture and data types and structures.

PHASE III DUAL USE APPLICATIONS: Adapt the capability from the prototype utilizing the new technologies and/or algorithms developed in Phase II into a mature, full scale, fieldable capability. Work with missile defense integrators to integrate the advancement into a missile defense system level test-bed and test in a relevant environment.

REFERENCES:

1. Dutta, P. and R. Bhattacharya. “Nonlinear Estimation of Hypersonic State Trajectories in Bayesian Framework with Polynomial Chaos.” Journal of Guidance Control and Dynamics 33 (2010): 1765-1778.

2. Sun, Tao & Xin, Ming. (2014). (Hypersonic Entry Vehicle State Estimation Using High-degree Cubature Kalman Filter). AIAA AVIATION 2014 -AIAA Atmospheric Flight Mechanics Conference. 10.2514/6.2014-2383.
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4. C. Shen et al., "Seamless GPS/Inertial Navigation System Based on Self-Learning Square-Root Cubature Kalman Filter," in IEEE Transactions on Industrial Electronics, vol. 68, no. 1, pp. 499-508, Jan. 2021, doi: 10.1109/TIE.2020.2967671.

KEYWORDS: Kalman, filter, IMU, inertial, artificial intelligence, machine learning, algorithm, navigation error, navigation, IMU

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MDA22-008 TITLE: Packaging High Temperature Electronics for Harsh Flight Environments

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics; Microelectronics

TECHNOLOGY AREA(S): Materials; Sensors; Electronics; Weapons

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OBJECTIVE: This topic seeks improved materials, techniques, and processes for integrating high temperature semiconductor dies into packages and higher levels of assembly. The packaged electronics should be robust and reliable enough to operate at 300°C or greater in the very harsh flight environment experienced by a missile defense interceptor.

DESCRIPTION: The electronics onboard a missile-defense interceptor must operate in a harsh environment. In particular, these electronics could reach high temperatures due to aero-heating, self-heating, and/or proximity to a propulsion system. High temperatures degrade electrical performance and weaken the ability to withstand mechanical and chemical stresses. Conventional silicon-based electronics fail above a certain temperature. Insulation, isolation, and/or cooling could help protect these electronics, but these protective measures also complicate the interceptor's design and increases its size, weight, and power (SWaP). There are, however, emerging solutions that could extend the upper limit of operating temperature in order to minimize the need for these protective measures.

This topic seeks to contribute towards the larger goal of advancing high temperature electronics (HTEs). Numerous advancements are needed in order to further mature HTEs and promote its wider adoption for MDA applications. Of these advancements, this topic specifically focuses on the challenge of packaging HTEs for harsh flight environments.

Of particular interest is the ability to attach and connect a high-temperature die to its package. Higher levels of integration are also of interest, but to a lesser extent. There are many complex integration challenges that must be overcome in order to maintain suitable thermal, mechanical, and electrical connections across a wide range of operating temperatures.

The exact mission and application is not specified in this topic and is open to suggestion. Examples include remote sensing, control, and actuator electronics located near heat-sources such as rocket engines, divert and attitude control systems, and aero-heated control surfaces. Examples also include power transistors and radiofrequency amplifiers that self-heat and are attached to a rapidly warming heat sink. Other suggestions would be considered but should be relevant to interceptor electronics.

For the purposes of this topic, MDA seeks packaged HTEs that can operate at temperatures greater than 300°C. This temperature is assumed to be near the practical upper limit for silicon-on-insulator (SOI) electronics. SOI electronics operating at 300°C or greater would be responsive to this topic. There is a desire to operate at even higher temperatures, using advanced semiconductor materials such as silicon carbide (SiC), if suitable dies and packages are available and affordable enough to support Phase I-III goals. The packaged HTEs might be concurrently exposed to high temperatures, shock (>100 g at lower frequencies and >1000 g at higher frequencies), vibration (>20 g-rms), and acceleration (>50 g). Depending on the application, the HTEs might also be exposed to air, propellant, oxidizer, and/or exhaust gases. They might start at sub-zero pre-launch temperatures, at sea-level, and then rise to high temperatures at near-vacuum pressures as the interceptor rapidly ascends. The HTEs might be exposed to natural and manmade radiation. Mission durations are <30 minutes and the interceptors are not reused afterward. These requirements seem very different than commercial HTE applications and even seem more stressing than space launches.

The following questions (among others) should be considered: What is the current state of the practice for HTE and associated packaging? How is the proposed approach innovative? What are its advantages and disadvantages compared to competing alternatives? What are its limitations? What are the developmental risks and contingency plans? How would the technology be commercialized in accordance with the Phase III goals? What high-demand applications, if any, have similar requirements? What other Government-funded efforts (to mature HTEs) could this SBIR augment?

Please note that the references listed below (in no particular order) were helpful for understanding the challenges of packaging HTEs. They should not be misconstrued as describing a preferred approach, organization, or technology. They should also not be misconstrued as describing the boundaries within which proposed solutions must fall. They may, however, be used as a benchmark to compare your proposed approach against.

Please also note that the technical objectives described within this topic are negotiable and may be adjusted based on pre-release feedback.

PHASE I: The objectives of Phase I are as follows: (1) Demonstrate the feasibility and benefit of the proposed approach compared to competing approaches. (2) Build a high-fidelity model of the proposed solution and simulate its electrical performance and robustness in the intended environment. (3) Develop a detailed and executable plan for experimentation and process development in Phase II. This includes creating a complete list and schedule of all of the experiments that would be performed during Phase II. It also includes gathering quotes (with lead-times) for all required materials, equipment, and services (to include back-up suppliers). Phase I is anticipated to be mostly labor, although a small amount may go to materials in order to measure basic properties (to inform models), gain early hands-on experience, and/or demonstrate proof-of-concept. No travel to Government facilities would be required during Phase I.

PHASE II: The objectives of Phase II are as follows: (1) Execute the plan developed during Phase I. (2) Continue to improve the fidelity of the model and your capabilities to simulate performance and robustness in harsh conditions. (3) Begin developing a workflow for packaging electronics (and screening for workmanship) that could be commercialized in Phase III. The overall approach should be to produce a large number of samples and take a large number of measurements with which to validate model predictions and inform the next steps. Start simple and incrementally add complexity as confidence in the model and processes increases. Likewise, electrical and environmental tests should start as simple measurements and then progress to flight-representative functional testing during exposure to concurrent environments. Near the end of the program, quantify the limits of the technology by testing to failure. Investigate failures and determine causes. The spend rate should start at Phase I levels and increase linearly to a maximum near the end of Phase II. Major equipment purchases should be deferred until needed in order to continue progress.

PHASE III DUAL USE APPLICATIONS: The goal of Phase III is to stand-up a sustainable service to package HTEs for missile defense applications, missile defense contractors, and other US-based customers. It is unlikely that the production volumes needed for missile defense would be large enough to sustain this capability after Phase III ends. Therefore, the offeror should consider (and identify) commercial and/or other defense applications that have similar requirements but that require larger volumes. Another possibility might be to down-market the product in order to meet the price point of customers with less stressing requirements. It is preferable that the offeror intends to provide this service themselves rather than selling or licensing the technology to another company. It is also worth noting that the focus of this SBIR is on integration, rather than the dies or packages themselves. Therefore, it would be acceptable (and in some ways preferable) for the offeror to source these items from other (preferably U.S.-based) suppliers. Other arrangements would be considered. The first flight of this technology would likely be as a redundant and nonessential component onboard a test vehicle, as part of that test vehicle's non-tactical instrumentation (i.e. telemetry package). Therefore, low SWaP and low electromagnetic emissions are crucial to avoid interfering with mission-critical systems and for allowing the packaged HTE to be collocated near existing components with which results could be compared against. Other transition pathways are possible and would be considered.

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2. Liang-Yu Chen, Robert S. Okojie, Philip G. Neudeck, Gary W. Hunter, and Shun-Tien T. Lin, "Packaging of High Temperature SiC Based Electronics", Accessed here: https://nepp.nasa.gov/docuploads/4AEA6FF5-2264-449C-AA1532A7EDFC931F/LiangyuChenLinks701Article.pdf.
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KEYWORDS: Electronics, high temperature, HTE, packaging, packages, die, attach, integration, silicon-on-insulator, SOI, silicon carbide, SiC, gallium nitride, GaN, wide bandgap, semiconductors

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VERSION 3

MDA22-009 TITLE: Homeland Defense Interceptor Technologies

OUSD (R&E) MODERNIZATION PRIORITY: Artificial Intelligence/ Machine Learning; 5G; Autonomy; Cybersecurity; Network Command, Control and Communications; Microelectronics; Space; Quantum Sciences

TECHNOLOGY AREA(S): Materials; Sensors; Electronics; Battlespace; Weapons

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OBJECTIVE: Develop innovative interceptor technologies, capabilities, and capacity to pace present and emerging threats.

DESCRIPTION: The Government faces a growing threat of ballistic missiles and needs future interceptor missiles to quickly respond and defeat them. The goal for missile defense is to provide the capability to pace the threat. To support this goal, improved and enhanced interceptor technologies, including booster and kill vehicle component technologies such as advanced materials, structures, propulsion and controls, seeker technology, guidance and navigation, and communications are desired. The innovative technologies include methods to decrease weight and improve fabrication methods that will improve capabilities and increase flight velocity and range. In order to meet the desired performance, these technologies will need to withstand natural and nuclear environments as well as dynamic and thermal environmental requirements.

This topic seeks technologies that improve reliability, lethality, sustainability, and survivability. Note survivability includes lightning, radiation, and thermal protection. In the midcourse when reentry vehicles, penetration aids, and decoys are deployed, discrimination is key. Technologies or capabilities which provide enhanced discrimination and reduce the number of called lethal objects are desired.

PHASE I: Develop conceptual, technical approaches that improve the reliability, lethality, sustainability, and survivability of booster and kill vehicle components and increase interceptor capability and capacity to mitigate threats. Perform trades and analysis to support the proposed design solutions. Perform bench-level testing to demonstrate the concept and an understanding of the new, innovative technology.

PHASE II: Develop and refine the proposed solution. The Phase I concept will be validated by development and demonstration tests to ensure performance objectives are met. The effort should result in a solution that can be transitioned in Phase III and/or can show substantial commercialization potential.

PHASE III DUAL USE APPLICATIONS: Conduct engineering and manufacturing development, test, evaluation in a realistic system environment or in a system level test-bed. The various technologies and models should have applicability to the defense industry as well as other application such as commercial space flight.

REFERENCES:

1. R. Lloyd. 2001. "Physics of Direct Hit and Near Miss Warhead Technology." American Institute of Aeronautics and Aeronautics.
2. National Research Council of the National Academies. 2012. "Making Sense of Ballistic Missile Defense: An Assessment of Concepts and Systems for U.S. Boost-Phase Missile Defense in Comparison to Other Alternatives."
3. Department of Defense. December 10, 2007. MIL-STD-461F, Department of Defense Interface Standard: Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.
4. James R. Schwank, Marty R. Shaneyfelt, and Paul E. Dodd, "Radiation Hardness Assurance Testing of Microelectronic Devices and Integrated Circuits: Radiation Environments, Physical Mechanisms, and Foundations for Hardness Assurance," IEEE Transactions on Nuclear Science, Vol. 60, No. 3, June 2013.

KEYWORDS: Cybersecurity, LWIR, Long-wave, Infrared, FPA, Detector, Solid Propulsion, Propulsion Components, Solid Component Geometries, Additive Manufacturing, Electronics Testing, Metamaterial, Power, Converter, DC-DC, Space, Radiation, Rad Hard, Reliability, Radi

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VERSION 3

MDA22-010 TITLE: Homeland Defense Weapon System Software Development Processes

OUSD (R&E) MODERNIZATION PRIORITY: Network Command, Control and Communications; Autonomy

TECHNOLOGY AREA(S): Information Systems

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OBJECTIVE: Develop a software development approach that leverages modernized tools, methods and technology that is efficient, repeatable and streamlined to meet mission goals in a Development, Security and Operations (DEVSECOPS) environment.

DESCRIPTION: The goal for missile defense is to provide capabilities to pace the threat and support new threat classes. To meet this goal, the Government is seeking innovative software development concepts to apply to future homeland defense weapon system software development processes to include enhanced automated software development qualification testing capabilities for rapid deployment of high quality and cyber-secured capabilities to the warfighter. A conceptual approach that leverages modernized tools, methods and technology that is efficient, repeatable and streamlined to meet mission goals is desired. The concept would need to include all supporting assumptions and documentation.

PHASE I: Develop conceptual technical approaches for conducting DEVSECOPS when there are weapon system performance requirements. This will include assumptions and conceptual architecture to inform how weapon system performance testing can be accomplished via DEVSECOPS automated tests.

PHASE II: Develop and refine the proposed solution. Validate by development and demonstration tests to ensure performance objectives are met. The effort should result in a solution that can be transitioned in Phase III.

PHASE III DUAL USE APPLICATIONS: Refine the phase II solution. Conduct software engineering and demonstrate automated test and evaluation in a realistic system environment for related performance requirements.

REFERENCES:

1. DOD-Enterprise-DEVSECOPS-2.0-Strategy-Guide: https://software.af.mil/wp-content/uploads/2021/05/DoD-Enterprise-DevSecOps-2.0-Strategy-Guide.pdf.
2. DOD Enterprise DEVSECOPS Reference Design Version 1.0 12 August 2019: https://dodcio.defense.gov/Portals/0/Documents/DoD%20Enterprise%20DevSecOps%20Reference%20Design%20v1.0_Public%20Release.pdf.

KEYWORDS: Development, Security, Operations

VERSION 3

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VERSION 3

MDA22-011 [TOPIC REMOVED]

VERSION 3

MDA22-012 TITLE: Ground Safing Enhancements

OUSD (R&E) MODERNIZATION PRIORITY: Network Command, Control and Communications; Autonomy

TECHNOLOGY AREA(S): Information Systems

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OBJECTIVE: Develop innovative technologies, capabilities, and capacity to provide ground safing alternatives for the interceptor to allow remote enabling/disabling of the missile fields while maintaining physical inhibit and safety requirements.

DESCRIPTION: The Ground Safing Device (GSD) provides the physical inhibit required to prevent unintended arming of the interceptor stage 1 motor. The GSD is a separate, physically isolated system from the operational command and control system. Currently the GSD requires a warfighter who is physically located at the readiness and control center at each site to manually enable/disable the GSD to allow for launch/safing of an interceptor complex. Safety also requires that the GSD remain in the last selected state after failure of any GSD system component or power loss. This presents operational concerns for the warfighter. An analysis into possible enhancements to the current GSD Concept of Operations (CONOPS) and design is needed. Enhancements should consider increasing reliability of the present system, allowing for remote enabling of the GSD at all sites from each Mission Operator command center (Fort Greely Alaska and Colorado Springs) and investigating methods for ensuring interceptor launch capability in the event of a GSD failure.

PHASE I: Develop conceptual, technical approaches that provide alternatives to present GSD CONOPS while maintaining safety considerations regarding inadvertent launch (i.e.; one physical launch inhibit). Improve the availability of the GSD by incorporating Mission Operator desire for remote GSDenabling at the Command and Control centers and to investigate methods for ensuring GSD failures do not preclude ability to launch. Perform trades and analysis to support the proposed design solutions. Perform bench-level testing to demonstrate the concept and an understanding of the new, innovative technology.

PHASE II: Develop and refine the proposed solution. The Phase I concept will be validated by development and demonstration tests to ensure performance objectives are met. The effort should result in a solution that can be transitioned in Phase III and/or can show substantial commercialization potential.

PHASE III DUAL USE APPLICATIONS: Conduct engineering and manufacturing development, test, evaluation in a realistic system environment or in a system level test-bed. The various technologies and models should have applicability to the defense industry as well as other applications for related missile defense and offense programs.

REFERENCES:

VERSION 3

1. Air Force Space Command Manual 91-710, Volume 3, 15 May 2019. Range Safety User Requirements Manual Volume 3 – Launch Vehicles, Payloads, And Ground Support Systems Requirements.
2. Military Standard System Safety Program Requirements MIL-STD-882C 19 Jan 1993.

KEYWORDS: Safety, Inhibit, Ground Safing Device

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MDA22-013 TITLE: Solid Propellant Oxidizer Alternative to Ammonium Perchlorate

OUSD (R&E) MODERNIZATION PRIORITY: Hypersonics

TECHNOLOGY AREA(S): Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Identify, develop, and demonstrate a solid propellant oxidizer alternative to Ammonium Perchlorate (AP).

DESCRIPTION: State-of-the-art composite solid propellants commonly use AP as an oxidizer. An alternative oxidizer to AP is needed to address potential future supply chain risk, and provide future missile systems increased performance while meeting Insensitive Munitions (IM) requirements set forth by 10 USC § 2389.

This topic seeks to develop and demonstrate an alternative oxidizer to AP in a solid propellant formulation with equal or greater performance (e.g. density-specific impulse) when compared to a typical AP/hydroxyl-terminated polybutadiene/aluminum composite propellant. Solutions must primarily address an AP alternative, but may also include changes to other constituents of the propellant formulation to compensate for performance differences associated with the oxidizer, if any.

Propellants formulated with the developmental oxidizer must achieve Hazard Classification 1.3C or better (less sensitive) and be able to pass the following standardized IM test parameters and passing criteria as defined by MIL-STD-2105D and associated NATO Standardization Agreement (STANAG): Fast Cook-off (STANAG 4240); Slow Cook-off (STANAG 4382); Bullet Impact (STANAG 4241); High-Velocity Fragment Impact (STANAG 4496); Sympathetic Detonation (STANAG 4396).

PHASE I: Develop a proof-of-concept solution; identify candidate oxidizer and conduct analyses for predicted performance and sensitivity for both the individual oxidizer ingredient and a composite propellant utilizing the candidate oxidizer. Perform initial sensitivity screening (electrostatic discharge, friction, shock, etc.) for the oxidizer. Results will be documented for Phase II.

PHASE II: Expand on Phase I results by producing oxidizer in sufficient quantity to fully characterize oxidizer sensitivity (making sure to consider potential increased sensitivity as a function of particle size), and formulate into a composite solid propellant. Demonstrate performance of propellant (via strand-burn burn rate and small scale motor hot-fire test). Demonstrate ability of propellant cast into a motor to pass the aforementioned IM tests, specifically slow cook-off and bullet impact. Manufacturing and quality control processes should be identified to minimize batch-to-batch variability.

PHASE III DUAL USE APPLICATIONS: The developed solution should have direct insertion potential into missile defense systems. Conduct engineering and manufacturing development, test, evaluation, qualification. Demonstration would include, but not limited to, demonstration in a real system or operation in a system level test-bed with insertion planning for a missile defense interceptor.

REFERENCES:

1. US Insensitive Munitions Policy Update, DTIC.
2. MIL-STD-2105D.
3. Yang, Brill, and Ren, "Solid Propellant Chemistry Combustion and Motor Interior Ballistics."
4. George P. Sutton, "Rocket propulsion Elements; Introduction to Engineering of Rockets" 7th edition, John Willey &Sons, 2001.

KEYWORDS: Insensitive Munitions, Propellant, Oxidizer, Propulsion, cook-off, bullet impact

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